Prophi® POWER FACTOR CONTROLLER

Hybrid switching

Harmonics display

Prophi®

```
AUTO MODE
─────────────
cosφ 0.987 IND
‡‡‡‡              ››
1 2 3 4 5 6 7 8 9 10 11 12
```

Blindleistungsregler
Power Factor
Controller

Auto
Program
Manual
Service

Enter
OK

Help

ESC

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Dynamic PFC

Smart control

Interfaces / communication
• RS485

Communication / protocols
• Modbus RTU
• Modbus KTR
• ASCII Out
• Extern
• Slave Hybrid
• Slave Mode
• Master Mode

Triple Safety
• Temperature monitoring
• Monitoring the capacitor protective switching cycles
• Monitoring of over-current
• Single-phase reactive current compensation monitoring

Measuring voltage
• 3-phase
  50–760 V (L-L), 30–440 V (L-N)
  30–525 V (L-N)

Power quality
• Harmonics up to the 33rd
• THD-U in%
• THD-I in%

Intelligent control
• Minimised number of switching cycles
• Compensated number of contactor switch cycles
• Optimised service life
• Mixed control (single and three-phase)
• Separate control of single-phase capacitors
• Sequential switching
• Cyclic switching

Switching outputs
• 15 relay outputs, freely programmable
• 12 transistor and 12 relay outputs for hybrid PFC

Alarm messages
• Undervoltage detection
• Overvoltage detection
• Under-compensation
• Measurement current exceedance
• Harmonics threshold values
• Delivery of active power
• Overtemperature
• Dropping below the measurement current
• C-defect
• Modbus error
• Switching cycle warning

Display mode
• Display three measured values simultaneously
• Graphical representation of harmonics in bar graph form
• Three-digit display of power factor (cos phi), switchable (tan phi)
• Display of controlled steps, fault messages and time
• Display of apparent current, active current and reactive current in display mode

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Areas of application

- Automatically regulated power factor correction
- Choked power factor correction
- Harmonics filter
- Voltage stabilisation by means of dynamic PFC
- Mixed operation (hybrid switching) contactors and thyristor switching

Fig.: Auto-Mode

Main features

- 12 or 13 switching outputs
- Extended measured voltage range (up to 760 V ~ L-L)
- Control of inductive compensation systems possible
- 20 pre-programmed control series
- Control series editor
- Graphical display 128 x 64 pixels
- Plain language menu navigation
- Four-quadrant operation
- Automatic initialisation
- Display of various grid parameters
- Display of harmonics
- Display of distortion factor THD-V / THD-I
- Monitoring of the capacitor current
- Saving of the maximum values
- Saving of the switching cycles and times
- Manual / Automatic mode
- Zero voltage shutdown
- Various error messages / alarm relay
- Error memory
- Test run of the system with error analysis
- Control of inductive compensation systems possible
- Voltage, current, frequency, active power, reactive power, apparent power
- Harmonics of the voltage (up to the 33rd / up to the 16th (even))
- Harmonics of the current (up to the 33rd / up to the 16th (even))

Fig.: Display-Mode

Alarm output programmable for ...

- Undervoltage detection / Overvoltage detection
- Under-compensation / Over-compensation
- Under-current / Over-current
- Harmonics threshold values
- Delivery of active power
- Overtemperature
- Message for delivery of active power
- Measured voltage error
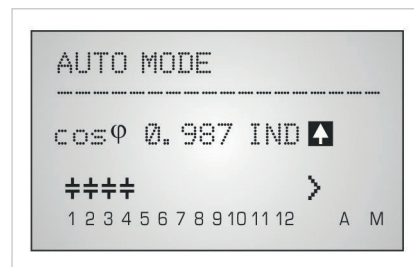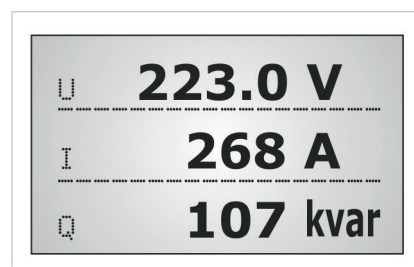- Switching cycle warning
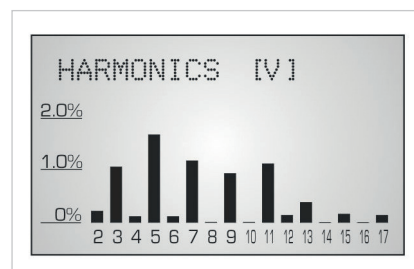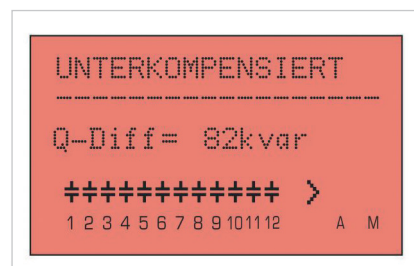- Modbus error
- C-defect

Fig.: Bargraph-Mode

Fig.: Error message (customisable backlight)

Functional principle

- Single-phase/three-phase electronic measurement system
- Detection of the reactive and active current portion of the grid via the current and voltage circuit
- Switching in or out of the capacitor stages via the outputs in the event of deviations in the set power factor
- Switching of capacitors via contactors or semiconductors
- Regulation via capacitor air contactors is implemented in an optimised manner
- Transistor outputs for the near-realtime control of semiconductor switches

Fan control

- Development of fan control via integrated temperature sensors and a fan
- Uses the signal relay
- Programming of a lower or upper limit temperature necessary

LCD display
- Graphical display 128 x 64 pixels
- Display a comprehensive selection of measurement parameters

Overtemperature shut-down

- The overtemperature shut-down switches off the capacitor stages connected
- This results in the reduction of the interior temperature of the switching cabinet and protects the capacitors
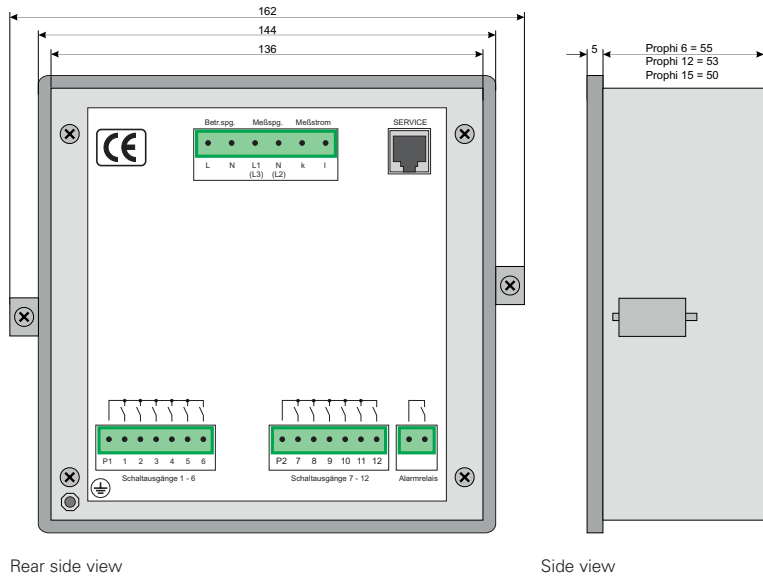- Programming of a lower or upper limit temperature as well as the pause time

Interface

- Two independent potential-free RS485 interfaces
- The Modbus RTU, Modbus KTR, ASCII out, Slave Hybrid, Slave Mode, and Master Mode protocols are available via the RS485s
- Integration of PLC systems, building management systems or energy management systems
- Modbus transfer rates: 9.6 – 256 kBit/s

Dimension diagrams

All dimensions in mm

Rear side view

Side view

Cut out: 138^{+0,8} x 138^{+0,8} mm
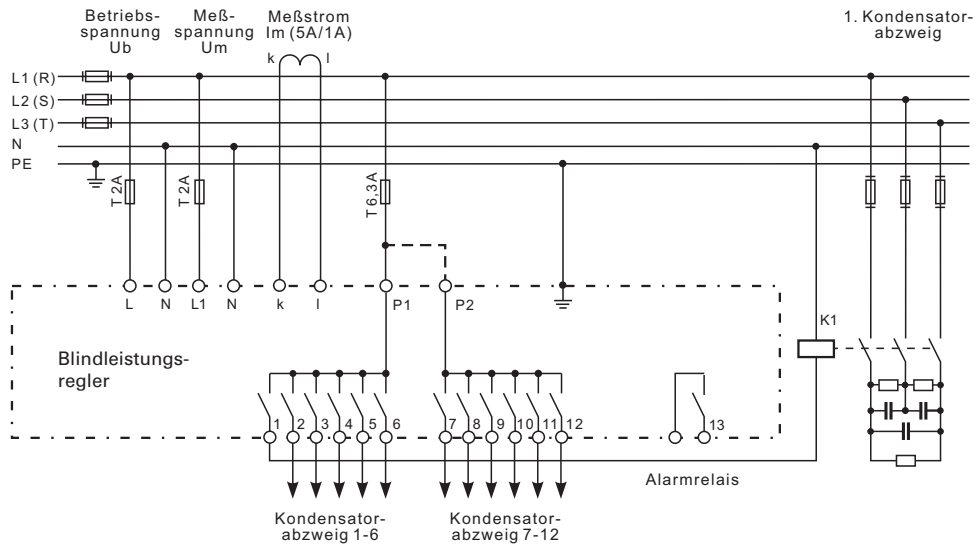
Typical connection

Fig.: Connection example for the Prophi® power factor controller

Device overview and technical data

Relay outputs (conventional)	Transistor outputs (dynamic)	Alarm output	Target cos-phi change over 1/2	Measurement voltage 30 – 440 V (L-N) 50 – 760 V (L-L) / Operating voltage 110 – 440 V ±15 %	Measurement voltage 30 – 525 V (L-N) / Operating voltage 110 – 230 V	RS485 interface	Software GridVis®-Basic	Dimensions in mm (W x H x D)	Weight in kg	Type	Item number
6	-	•	-	-	•	-	-	144 x 144 x 55	1	Prophi® 6R	14.16.038
12	-	•	-	•	-	-	-	144 x 144 x 53	1	Prophi® 12R	14.16.028
-	6	•	-	-	•	-	-	144 x 144 x 55	1	Prophi® 6T	14.16.039
-	12	•	-	•	-	-	-	144 x 144 x 53	1	Prophi® 12T	14.16.033
12	12	•	-	•	-	-	-	144 x 144 x 53	1	Prophi® 12TR	14.16.040
12	-	•	•	•	-	•	-	144 x 144 x 53	1	Prophi® 12RS	14.16.029
12	12	•	•	•	-	•	-	144 x 144 x 53	1	Prophi® 12TRS	14.16.036
-	12	•	•	•	-	•	-	144 x 144 x 53	1	Prophi® 12TS	14.16.041
15	-	•	•	•	-	•	-	144 x 144 x 50	1	Prophi® 15R III	14.16.037
-	15	•	•	•	-	•	-	144 x 144 x 50	1	Prophi® 15T III	14.16.042

• = included   - = not possible

General	Prophi®
Use in low and medium voltage networks L-N or L-L	•
Accuracy voltage measurement	1%
Accuracy current measurement	1%
Accuracy cosphi measurement	1%
Accuracy power measurement	2%
Accuracy frequency measurement	1%
Accuracy harmonics measurement	2%
RMS – momentary value	
Current, voltage, frequency	•
Effective, reactive and apparent power	•
Power factor	•
Recording of the mean values	
Power factor	•
Power quality measurement	
Harmonics per order / current and voltage, 1-phase	Prophi 6: 3.–19., odd Prophi 12: 3.–33., odd Prophi 15: 3.–33., odd
Distortion factor THD-U in%, 1-phase	•
Distortion factor THD-I in%, 1-phase	•
Measured data recording	
Maximum values	•
Displays and inputs / outputs	
Digital display, 4 / 6 buttons	•
Relay outputs (as switch output)	6 / 12 / 15 See overview of devices
Transistor outputs (as switch output)	6 / 12 / 15 See overview of devices
Alarm output (as switch output)	1
Digital input (for tariff changeover)	1 See overview of devices
Temperature sensor (internal)	1

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Communication	
Interface	
RS485: 9,6–256 kbps	See overview of devices
Protocols	
Modbus RTU	•
Error messages	
Under-voltage / over-voltage	•
Under compensated / over compensated	•
Measuring current underrun	•
Overtemperature	•
Harmonics (harmonic distortion)	•
Overcurrent	•
Switching cycle warning	•
Service interval	•

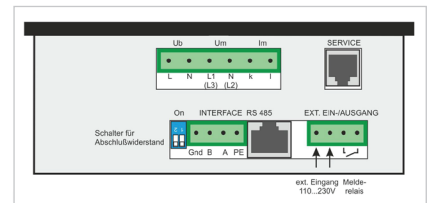| **Technical data**	
Supply voltage L-L, L-N AC	See overview of devices
Measurement in which quadrants	4
Networks	TN, TT, (IT)
Measurement in multi-phase networks	3 ph
Power consumption	max. 5 VA
Measured voltage input	
Overvoltage category	CAT III
Measured range, voltage L-N, AC (without potential transformer)	See overview of devices
Measured range, voltage L-L, AC (without potential transformer)	See overview of devices
Voltage tolerance range	+10% , -15%
Back-up fuse	2 A ... 10 AT
Measurement surge voltage	4 kV
Test voltage relative to ground	2.200 V AC
Frequency measuring range	42 ... 80 Hz
Sampling rate	10 kHz (at 50 Hz)
Measured current input	
Signal frequency (Basic frequency)	45 ... 80 Hz
Nominal current at .../5 A (.../1 A)	5 A (1 A)
Operating current	50 mA (10 mA)
Upper measurement current	6 A
Power consumption	approx. 0.2 VA
Updating the display	1 time per second
Zero voltage triggering	< 15 ms
Inputs and outputs	
Number of digital inputs (for tariff changeover)	1, see overview of devices
Relay outputs (as switch output)	6 / 12 / 15, see overview of devices
Back-up fuse	10 AT
Switching voltage (relay)	max. 250 V AC
Switching power	max. 1.000 W

Fig.: Prophi® interface

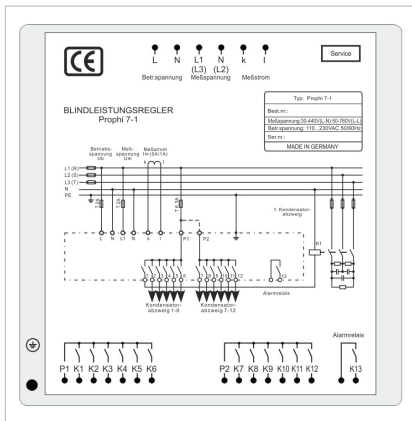|	
Mechanical service life	$> 10^7$ switching cycles
Electrical service life	$> 10^5$ switching cycles
Transistor outputs (as switch output)	**6 / 12, see overview of devices**
Switching voltage (transistor)	5 ... 30 V DC
Switching current (transistor)	max. 50 mA
Alarm output (as switch output)	1
Target cosphi changeover (current consumption)	Input 230 V AC
Mechanical properties	
Weight	1000 g
Device dimensions in mm (W x H x D)	see overview of device
Protection class per IEC 60529	Front: IP54, Rear: IP20
Installation	Front panel installation
Connecting phase (U / I), Single core, multi-core, fine-stranded Terminal pins, core end sheath	0.08 to 2.5 mm² 1.5 mm²
Features	
Display of capacitor currents	•
Display of switch-on times for the individual stages	•
Display of switching cycles per stage (only relay)	•
Zero voltage triggering	•
Automatic configuration	•
Password protection	•
Environmental conditions	
Temperature range	Operation: -10 ... +55 °C *1 Storage: -20 ... +60 °C
Relative humidity	15 to 95%
Operating altitude	0 ... 2,000 m above sea level
Degree of pollution	2
Mounting position	any
Electromagnetic compatibility	
Electromagnetic compatibility of equipment	Directive 2004/108/EC
Electrical appliances for application within particular voltage limits	Directive 2006/95/EC
Equipment safety	
Safety requirements for electrical equipment for measurement, regulation, control and laboratory use – Part 1: General requirements	IEC/EN 61010-1
Part 2 – 008: Particular requirements for testing and measuring circuits	IEC/EN 61010-1-08
Protection class	I = Device with protective conductor
Noise immunity	
Industrial environment	DIN EN 61326-1, Table 2; (IEC 61326-1)
Emissions	
Class B: Residential environment	DIN EN 61326-1; (IEC 61326-1)
Class A: Industrial environment	DIN EN 61326-1; (IEC 61326-1)
Safety	
Europe	CE labelling

Fig.: Prophi® rear view

Comment: For detailed technical information please refer to the operation manual and the Modbus address list.

*1 Devices with the "RS485 interface" option are only suitable for an operating temperature range of -10 to +50 °C.